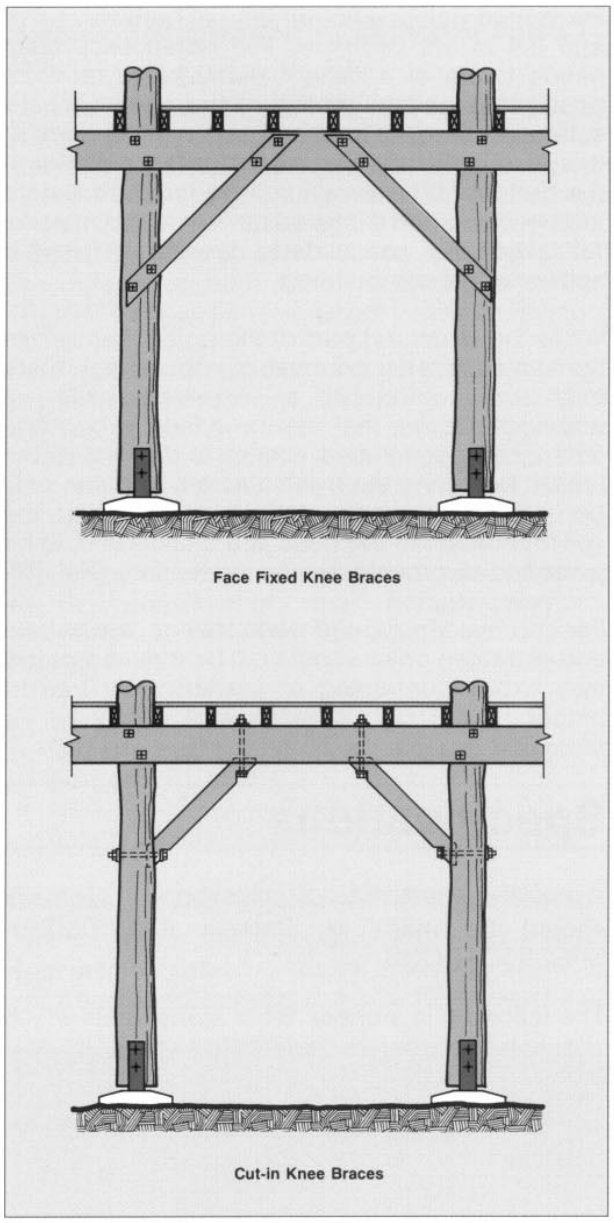


FIGURE 18 TIMBER KNEE BRACES

Poles create the core structure of this multi-level house design

Bracing walls should be as close to the poles as practical and these elements should be distributed uniformly throughout the building so that the horizontal diaphragms of the floor and ceilings are effective. When the ease of construction of the floor diaphragm is considered the strip floor is easiest to install around poles while sheet flooring is best used with pole grids set to the same module.

TABLE 14 TYPICAL RACKING STRENGTHS

Timber Brace	Plasterboard	Plywood
1 kN/m	2.5 kN/m	4 kN/m

Detailing for Shrinkage

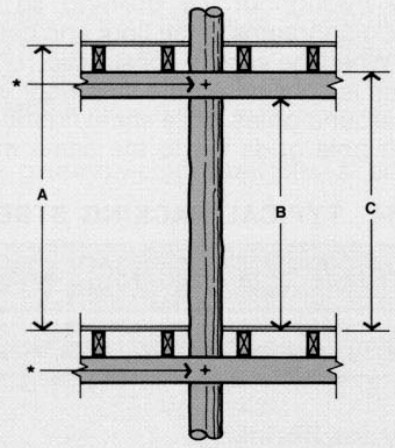
Timbers used in USA and NZ for pole construction are either low shrinkage or seasoned. Because of the high joint carrying capacities of Australian hardwood, unseasoned hardwood is often used here. In conventionally framed multi-storey structures, the shrinkage in the bearers, joists and wall plates causes the whole building to move downwards as the timber seasons over the first few years of life. In pole frame construction, each level is virtually fixed and shrinkage in the framing will result in movement between the top plates and the floor/roof above. Refer Figure 19. Species of high shrinkage (>8%) and which are collapse prone should not be used unseasoned.

The joints should be executed to accommodate this movement and, in addition, cornices should be shadow fixed to conceal this movement internally. Usually, conventional timber strip cladding will accommodate this movement without distress but more thought may have to be given in detailing for sheet cladding.

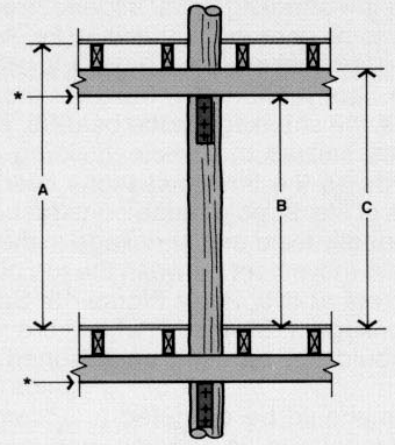
In order to accommodate the shrinkage, all bolts passing through the poles should have sufficient thread to permit later tightening. 40 mm is usually sufficient and re-tensioning of the bolts should be performed 6 months after construction as a minimum. It is important that the nuts are accessible so that this operation may be performed easily, otherwise a reduction in the joints capacity will occur. Structural square washers should be used at all bolt head/nut to timber interfaces as per Table 15.

TABLE 15 MINIMUM SIZE SQUARE WASHERS FOR STRUCTURALLY BOLTED JOINTS

Bolt Size	Size (mm)	Thickness (mm)
M12	50	3
M16	57	4
M20	65	5
>M20	75	6



Bolted Beams



Beams on Seats

* - Represents a fixed level in the structure regardless of shrinkage movement.

A- Dimension remains fixed provided similar members are used in both levels of framing.

B- Dimension increases due to shrinkage in the joists and beams and walls under this beam have to be detailed accordingly.

C- Dimension increase is due to the joist movement alone, i.e. most shrinkage worries are eliminated if seasoned joists are used.

FIGURE 19 SHRINKAGE — UNSEASONED FLOOR FRAMING

Construction

Where poles are driven, they are placed small end down and this significantly affects the stiffness of the system. If the foundation is fine grained and homogeneous then reasonable alignment may be achieved. The accuracy of driving can be assisted by pre-boring to 90% of the small end diameter. Regardless of the trouble taken, the driven pole alignment is such as to be unsuitable for pole frame construction and only practically suited to pole platform construction where misalignment of poles can be compensated for by using cantilever overhang and where the location of the bearer on top of the pile can be varied.

For potted poles, embedments of between 1.5 m and 2.4 m are common. The bored excavation needs to be of sufficient diameter to facilitate positioning and plumbing of the pole with still sufficient room to allow compaction of the backfill. It is also important that all disturbed material at the bottom of the excavation be removed before the punching pad is placed otherwise this material will eventually consolidate, causing differential settlement of the building.

While the structural part of the poles themselves are treated to resist extremes of insect attack, there may be a central pith or untreated section of embedded poles that can be attacked by white ants, giving concealed access to the rest of the timber frame. As the traditional ant cap can only be used with the pole platform construction, the soil foundation or the base and backfill should be poisoned to provide termite protection. (Ref 16).

For improved in-ground performance, the bottom end of treated poles should not be trimmed as this may expose untreated or inadequately treated timber.

Specifications

For recommended specification clauses, reference should be made to Datafile SP1 TIMBER SPECIFICATIONS.

The following is a check list of some items which should be included in specifications covering pole frame structures.

- Poles
  - species
  - size
  - grade
  - preservative treatment
  - sealing/end-plating
- Framing Timbers
  - species
  - sizes
  - stress grades
  - end-sealing
  - seasoned or unseasoned
  - preservative treatment
  - dressed or sawn finish
- Workmanship and Quality
- Fixings
  - fastener type/size/number
  - hot dipped galvanised finish
  - edge and end distances
- Finishing — if appropriate
- Maintenance — tightening of connections at completion of project.

Sample Specification — Softwood Poles (Pine)

"All building poles shall be of a single species, namely [insert common name of softwood species listed in AS 2209, Table 4.1], or of other agreed species and shall comply with the requirements of AS 2209, TIMBER POLES FOR OVERHEAD LINES, Sections 1, 4 and 5. The maximum limits for defects in both barrel checking and end-splitting as specified in Section 1 shall be Rating 1.

Softwood building poles shall be given full length preservative treatment according to AS 2209, Section 5, including minimum retention levels as in clause 5.6.1. or to minimum levels described in Queensland TUMA, New South Wales TMA, as suitable for in-ground application.

Markings for preservative treated poles supplied to this specification shall comply with the requirements of (strike out which ever do not apply).

— AS 2209 Clause 5.10 or
— Queensland Timber Utilisation and Marketing Act, or
— New South Wales Timber Marketing Act, or
— (insert special requirements of purchaser)"

Sample Specification — Hardwood Poles

"All hardwood building poles shall be of a single species, namely . . . [insert common name of softwood species listed in AS 2209, Appendix A], and shall comply with the requirements of AS 2209, TIMBER POLES FOR OVERHEAD LINES, Sections 1 and 5 and Section 2 or 3. The maximum limits for defects in both barrel checking and end-splitting as specified in Section 1 shall be Rating 2.

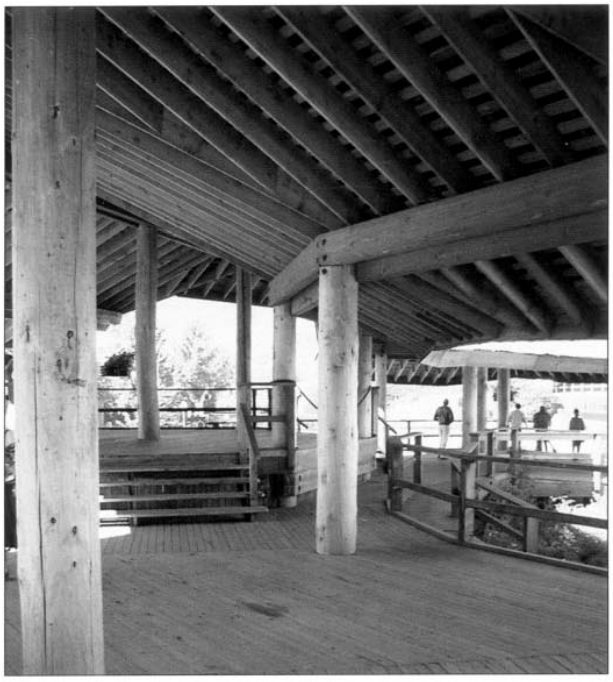
Hardwood building poles shall be:

— de-sapped prior to delivery, at least from bottom end to 600 mm above ground level) or
— treated full length to comply with AS 2209, Sections 3 & 4. [strike out whichever does not apply]

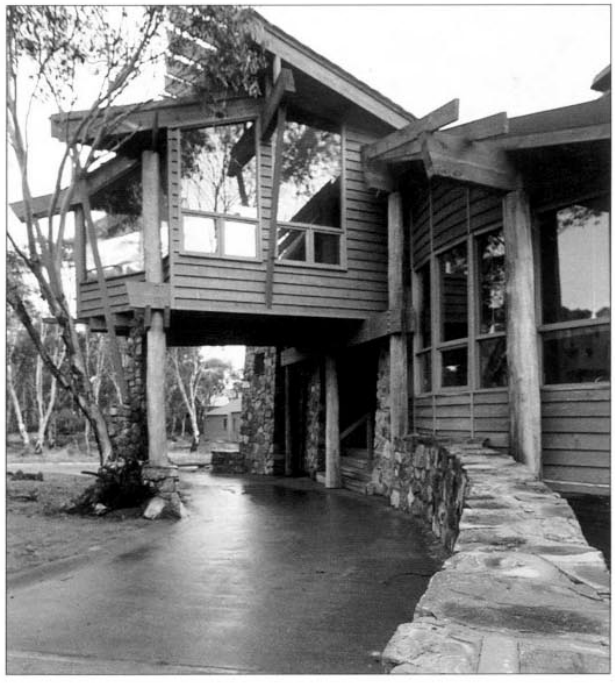
Hardwood building poles shall be given full length preservative treatment according to AS 2209 Section 5, including minimum retention levels as in clause 5.6.1. or to minimum levels described in Queensland Timber Utilisation and Marketing Act, New South Wales Timber Marketing Act, as suitable for in-ground application. Untreated Durability Class 1 or Class 2 hardwood building poles shall be suitably identified as to species.

Markings for preservative treated poles supplied to this specification shall comply with the requirements of (strike out which ever do not apply).

— AS 2209, Clause 5.10 or
— Queensland Timber Utilisation and Marketing Act, or
— New South Wales Timber Marketing Act, or
— (insert special requirements of purchaser)"



Pole roof structure provides shelter in outdoor recreation area



Alpine house shows design versatility of pole framed construction

Other References

1. HOW TO DESIGN POLE TYPE BUILDINGS.
Patterson, American Wood Preservers Institute.

2. DESIGNS FOR POLE FRAME BUILDINGS.
Bournon, R.N. & Keating, W.G. — Forest Products Technical Note No. 7, April, 1971.

3. EMBEDMENT DEPTH FOR NON-CONSTRAINED AND CONSTRAINED POLES OR POSTS.
Saghera S.S. — American Society of Civil Engineers May, 1973.

4. POLE FRAMES AND THE ENVIRONMENT.
Seminar School of Forestry, University of Canterbury, NZ May 1976.

5. POLE HOUSING: DESIGN AND PRACTICE.
Seminar School of Forestry, University of Canterbury, NZ May 1977.

6. POLE STRUCTURES.
Walford G.B., Australia — UNIDO Workshop, Timber Engineering, Melbourne, May 1983.

7. NATIONAL POLE CONFERENCE.
Capricornia Institute of Advanced Education, September 1985.

8. THE STAVE CHURCHES OF NORWAY.
Aune P., Sack R.L. Selberg A., — Scientific American, August 1983.

9. EFFECTIVENESS OF POLE FRAME STRUCTURAL BRACING.
Phillips M.H., Ministry of Works and Development, NZ, Report 5-85/16 — September 1985.

10. DETERIORATION OF MARINE TIMBER PILED STRUCTURES BY FUNGI, TERMITES & CRUSTACEAN MARINE BORERS.
Cookson L.J., Workshop on Marine Timber Piled Structures, Monash University, September 1984.

11. WOOD BORING MOLLUSCS.
Ibrahim J., Workshop on Marine Timber Piled Structures, Monash University, September 1984.

12. FOUNDATION ANALYSIS AND DESIGN.
Bowles J.E., McGraw — Hill International Book Co., 3rd. edition 1984.

13. AS 1604 — PRESERVATIVE TREATMENT FOR SAWN TIMBER, VENEER AND PLYWOOD.
Standards Australia.

14. AS 1684 — SAA TIMBER FRAMING CODE.
Standards Australia.

15. AS 1720 — SAA TIMBER STRUCTURES CODE.
Standards Australia.

16. AS 2057 — PROTECTION OF BUILDINGS FROM SUBTERRANEAN TERMITES — CHEMICAL TREATMENT OF SOIL FOR BUILDINGS UNDER CONSTRUCTION.
Standards Australia.

17. AS 2159 — SAA PILING CODE.
Standards Australia.

18. AS 2209 — TIMBER POLES FOR OVERHEAD LINES.
Standards Australia.

19. DESIGN OF LATERALLY LOADED PILES.
CIRIA Report 103.

20. THE DESIGN OF DEEP FOUNDATIONS IN EXPANSIVE SOILS IN SEMI-ARID AREAS.
McAnally, P.A. Australian Geomechanics Journal, 1973.

21. AS 1170 — SAA LOADING CODE, PART 2 — WIND FORCES.
Standards Australia.

FOR FURTHER INFORMATION CONTACT THE FOLLOWING:

Forest Products Association (WA),	103 Colin Street, West Perth, WA 6005	PH: (09) 322 2088	FAX: (09) 481 1019
NSW Timber Advisory Council,	27 Oratava Avenue, West Pennant Hills, NSW 2120	PH: (02) 871 1722	FAX: (02) 872 5565
Plywood Association of Australia,	3 Dunlop Street, Newstead, Qld 4006	PH: (07) 854 1228	FAX: (07) 252 4769
Radiata Pine Association of Australia,	10 Pitt Street, Parramatta, NSW 2150	PH: (02) 891 2766	FAX: (02) 635 3868
Tasmanian Timber Promotion Board,	68 York Street, Launceston, Tas 7250	PH: (003) 31 6077	FAX: (003) 31 1679
Timber and Building Materials Association (NSW) Limited,	13-29 Nichols Street, Surry Hills, NSW 2010	PH: (02) 360 3088	FAX: (02) 360 3464
Timber Development Association NSW Ltd,	525 Elizabeth Street, South, Sydney, NSW 2012	PH: (02) 699 1388	FAX: (02) 699 8068
Timber Development Association of SA,	113 Anzac Highway, Ashford, SA 5035	PH: (08) 297 0044	FAX: (08) 297 2772
Timber Merchants Association of Victoria,	180-184 Whitehorse Road, Blackburn, Vic 3130	PH: (03) 877 2000	FAX: (03) 877 6663
Timber Promotion Council of Victoria,	932 Swanston Street, Carlton, Vic 3053	PH: (03) 347 6322	FAX: (03) 347 1226
Timber Research and Development Advisory Council of Queensland (Timber Facts),	5 Dunlop Street, Newstead, Qld 4006	PH: (07) 852 1344	FAX: (07) 252 2607

TIMBER . . ENVIRONMENTALLY THE ONLY CHOICE FOR BUILDING AUSTRALIA'S FUTURE

PRINTED 9/89